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Use of Anterior Segment Imaging Adapter for Diagnosing Cataract Patients: A Case Series

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Abstract- To evaluate the utility and clinical relevance of an anterior segment imaging adapter attached to a smartphone for diagnosing and documenting various forms of cataract in a real-world setting. This case series presents five patients diagnosed with different types of cataracts using an anterior segment imaging adapter (e.g., a smartphone-mounted slit-lamp adapter). High-resolution anterior segment images were captured in outpatient settings, allowing for detailed visualization and classification of lens opacities. Clinical data, patient history, slit-lamp findings, and visual acuity were recorded for each case.

Keywords-Cataract, Anterior Segment Imaging, Smartphone Ophthalmology, Slit-Lamp Adapter ,Cataract Diagnosis, Portable Imaging, Teleophthalmology.

I. INTRODUCTION

Purpose: To describe a case series using the 3D printed smartphone adapter for mobile anterior segment ophthalmoscopy in cataract patients on a hospital-based population and interpret the possibilities of the ophthalmology adapter for off-site use.

Patients and methods: Patients with senile cataract with age between 60-80 years planned for undergoing phacoemulsification with implantation of an IOL were examined with a standard biomicroscope and results were documented with the TOPCON ImageNet i-base version: 3.14.3. Additionally they were examined with the 3D printed smartphone adapter for mobile anterior segment ophthalmoscopy - Smart Eye Camera (SEC). Standard preoperative examination protocol for cataract patients was followed.

Imaging System: The portable Smart Eye Camera system for anterior eye segment imaging consists of a special adapter with a slit module and blue filter mounted to an iPhone 8. The software used is Smart Eye Camera (SEC).

The device is shown below.

Results: We managed to document a series of patients with different stages of senile cataract and proved the 3D printed smartphone adapter for mobile anterior segment ophthalmoscopy to be a user-friendly device, acquiring a safe, picture-based documentation of clinical results during patient visits. It showed itself to be a reliable ophthalmologic supplement and can be used not only at the hospital, but also during off-site examinations, helpful in preventive check-ups and examination of patients in hard-to-reach areas without specialized medical facilities.

Discussion:
Cataract is one of the most common age-related ophthalmic conditions where the previously clear lens becomes opacified and obstructs light flow. It is a condition that progresses gradually and is among

the leading causes of vision impairment and reversible blindness at a global level [1]. Cataracts in their variety cause abt. 40% of blindness worldwide and result in 20M blind people. The disease incidence decreases as the country's economic standard rises. Although the cataract surgery is one of the most cost-effective of all health-care interventions, only 17% of people with vision impairment or blindness due to a cataract have received access to quality treatment [2].

Clinically, a cataract is diagnosed by careful examination in both dilated and undilated state of the pupil with a slit lamp and in this case series - also with the adapter for mobile anterior segment ophthalmoscopy.

Cataracts - regardless of the subtype - age-related, traumatic, metabolic, etc. lead to a gradual decline in the visual acuity that is impossible to be corrected with glasses and cause difficulty reading in dim light, blurry vision, night vision difficulties, glare and halos around lights, and occasionally double vision. As a result - the quality of life is affected.

In our case series we present cataracts that are mostly age-related and uncomplicated by systemic conditions. A common finding in our patients was a central lenticular opacity. We could also nicely observe the altered lens structure according to the grade of mydriasis. All of our patients presented with a myopic shift and complaints of poor vision at night.

During the preoperative visit, a thorough medical history was taken from each patient and medication intake was documented. The ophthalmologic examination in all patients included best-corrected visual acuity (BCVA/VA), tonometry, slit-lamp examination with both standard biomicroscope equipped with an imaging system and the portable Smart Eye Camera system for anterior eye segment imaging, fundus examination through dilated pupils. For evaluating and grading the stage of a patients' cataract we used the LOCS III system - a reliable and reproducible grading scheme, helpful in establishing dependable and consistent grading. [3]Performing an additional exam with the add-on device, that allows visualization and photography of the anterior segment of the eye in our case series, allowed us to demonstrate the reliability of the anterior segment imaging adapter.

Because of the widespread use of smartphones and significant improvements to their camera function, their role in medicine is continuously evolving as they could replace a typically costly, difficult for transportation and expert-controlled-equipment what is frequently unavailable in underserved areas in developing countries. Nevertheless, the rapidly expanding telecommunication services in those areas allows the online transmission of the collected data to experts in distant locations for analysis and enhances the accessibility and cost-efficiency [4][5].

Case 1:

A 63-year old Caucasian woman presented to our outpatient clinic with blurry and hazy vision. The patient has a past history of hypertension. Her blood pressure was 130/80mmHg controlled with medications. There was no history of eye trauma. On examination, her visual acuity (VA) was 0.5 on the right eye and corrected the visual acuity with a pin hole to 0.6. Both imaging modalities defined the opacification as 1NCI/ LOCS III (Fig. 1) Anterior segment examination of the left eye showed no presence of inflammation. There was no eye discharge. Intraocular pressure was within normal range. The patient was advised to undergo a cataract operation because of her active lifestyle and feeling uncomfortable with glasses, and was given a good prognosis. The patient underwent a phacoemulsification with IOL-implantation under local anesthesia. Post-operatively, her VA improved to 1.0.

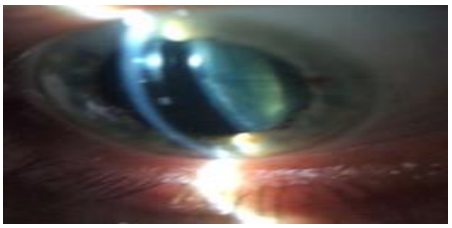

Fig.1NCI/ LOCS II

Case 2:

A 68-year old Caucasian presented in our clinic with complaints of blurry vision and difficulties while driving at night. The ophthalmological exam showed that the patients' best-corrected visual acuity was

0.6, normal tension on both eyes, anterior chamber angle width was normal and nucleocortical opacification without other accompanying ocular conditions. The patients' medical history allowed recent planning of the ophthalmic surgical intervention. The lens opacification (NC II/ LOCS III) was documented with the portable Smart Eye Camera system for anterior eye segment imaging in myotic condition as shown below Fig.2. The phacoemulsification with IOL-implantation under local anesthesia was conducted according to the standard methodology without any complications and the patients' VA one-week post-surgery was 1.0.

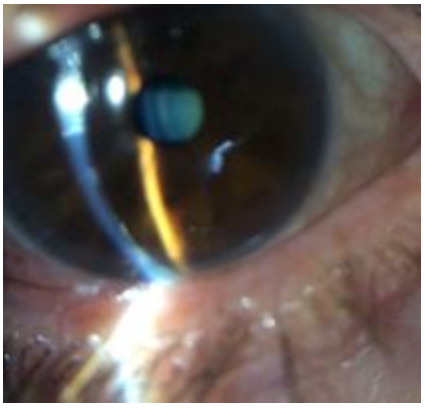

Fig.2 NC II/ LOCS III (myosis)

Case 3:

A 59-year-old-male presented with painless decrease of vision in both eyes, and predominantly of the left eye for the past year. Well-controlled arterial hypertension was the only condition of the patient. Because of the complaints of glare and double vision as also his active lifestyle the patient wanted to undergo a cataract surgery as soon as possible. The ophthalmological examination showed no contraindications for the procedure. BCVA was 0.7, IOP within the normal range, no anterior chamber abnormalities, no pathological conditions of the fundus. The opacificated lens NC II/ LOCS III, shown on Fig. 3, was operated without complications and a post-operative visual acuity of 1.0 was achieved.

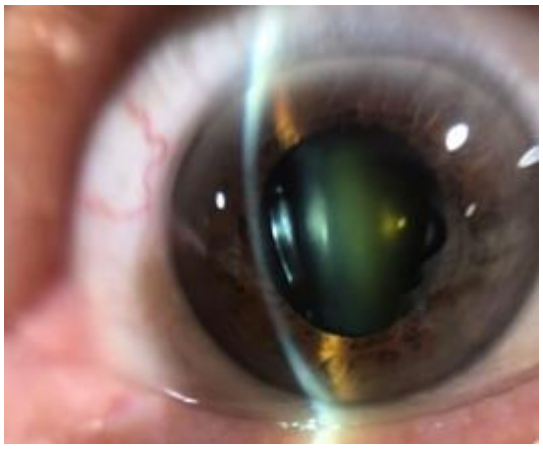

Fig.3 NC II/ LOCS III

Case 4:

During an in-hospital consultation of a patient from the endocrinology clinic a 72-year-old-male with diabetes mellitus and prostate condition presented to our clinic. BCVA was 0.4-0.5, bilateral normal tension, lens opacification NC III/ LOCS III (Fig.4), no anterior chamber irregularities, fundus with mild nonproliferative diabetic retinopathy. The prostate medication was discontinued preoperatively and the surgical procedure was performed without complications. Three days after the surgery the VA increased to 0.8-0.9 and appropriate conditions for conducting follow-up of the diabetic retinopathy were ensured.

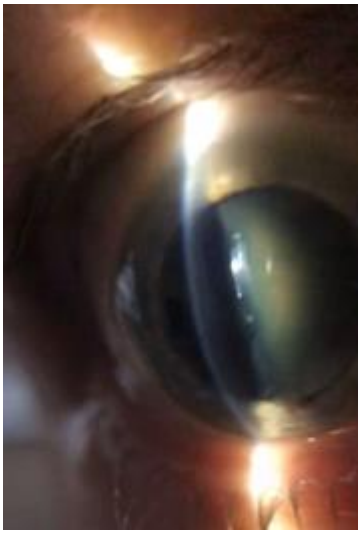

Fig.4 NC III/ LOCS III

Case 5:
A 73-year-old woman presented at our clinic with complaints of double vision, hazy and blurry vision. She has a family history of age-related macular degeneration that couldn't be closely monitored because of the NC IV/ LOCS III opacification of the lens (Fig.5) and unclear imaging of the retina. The VA of the patient was 0.3-0.4 with no possibility of further correction with stenopic hole. No pathological ophthalmic findings were documented during the preoperative examination. The surgical procedure was uncomplicated and the patient acquired a VA of 0.7 five days post surgery. The clear refractive media now allow strict monitoring of the macular condition.

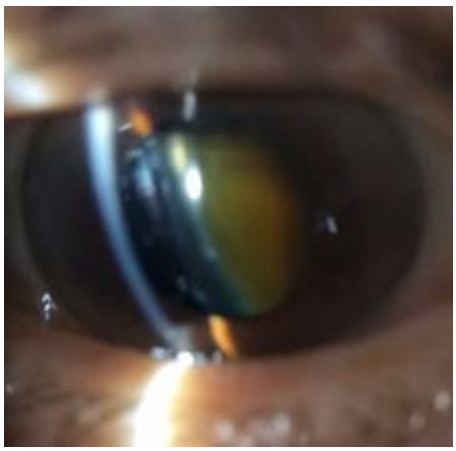

Fig.5 NC IV/ LOCS III

Case 6:
A 78-year-old Caucasian man presented to our clinic with a thirty-day history of intermittent right-sided headache. The patient experienced no nausea and mentioned no vomiting. He has hypertension and takes medication. The vision of the right eye had deteriorated over the past 10-12 months. He presented with white pupil and visual acuity of 0.01-0.02. Intraocular pressure of the right eye was high at 26 mmHg. The patient was advised to undergo a cataract operation and was given a guarded prognosis. Topical beta-blocker and a prostaglandin analogue were administered which led to the reduction of IOP to 19mmHg. The patient underwent a phacoemulsification with IOL-implantation under local anesthesia without any complications. Post-operatively, on the second day, his VA improved to 0.5 and IOP 17mmHg.

Fig.6 NC V/ LOCS III (myosis)

II. CONCLUSION

The treatment of cataracts requires an extensive medical eye examination, early detection and prompt surgical intervention. Organized community initiatives are critical to raising awareness of the potential consequences from not performing a cataract surgery on time.

In our case series we have proven the validity and credibility of the documented clinical findings with the 3D printed smartphone adapter for mobile anterior segment ophthalmoscopy.

The 3D printed smartphone adapter for mobile anterior segment ophthalmoscopy has proven to be the key device to help colleagues in low-and middle-income regions without specialized medical facilities to timely diagnose the cataract and schedule a patient for surgery as they are an important component that has the potential to greatly affect how the whole process turns out. It may be very useful in the initial evaluation of emergency patients in the emergency room or in screening examinations off site.

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